

SWIMMING POOL & SPA

OPERATOR GUIDE



COUNTY OF SAN DIEGO
DEPARTMENT OF ENVIRONMENTAL HEALTH

INTRODUCTION

The Department of Environmental Health of San Diego County currently oversees the operation of over 6,000 public swimming pools and spas located at community centers, high schools, apartments and condominiums. As you know, a well-maintained and supervised swimming pool is a real asset to any community, providing an environment for safe and healthy family recreation. But on the other hand a swimming pool improperly maintained and supervised can be a site of danger, disease and even death.

This booklet was written for the novice public swimming pool operator, with the hope of providing general knowledge of the major issues involved in the day to day maintenance and operation of a swimming/spa pool.

The booklet covers Pool Safety, Recirculation Systems, Decking and Fencing, Water Chemistry, Pool Sizing and Formulas. We have also included a glossary of swimming pool terms and a place to record important information about your pool or spa.

It is the hope and recommendation of this Department that anyone with the responsibility of operating, maintaining or supervising a public swimming pool become as informed as possible. Becoming a "**CERTIFIED POOL OPERATOR**" is an excellent way to acquire the necessary knowledge. Information about classes and certification can be obtained by calling (619) 338-2222.

Sincerely,

GARY W. ERBECK, Director
Department of Environmental Health

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POOL SAFETY

REQUIRED SAFETY EQUIPMENT: In order to effect a quick rescue, each swimming pool shall provide the following readily accessible safety equipment:

LIFE RING-With attached length of 3/16-inch line, long enough to span the maximum width of the pool. Exception; spa pools, no life ring required

RESCUE POLE-Minimum 12-foot pole with body hook securely attached to one end.

REQUIRED SAFETY SIGNS: The following safety signs shall be posted and readily visible to bathers in the pool area:

- * NO LIFEGUARD ON DUTY - "Children Under the Age of 14 Should Not Use Pool Without an Adult in Attendance".
- * ARTIFICIAL RESPIRATION PROCEDURES - with pictorial diagram of procedures.
- * EMERGENCY TELEPHONE NUMBER - (9-1-1)
- * OCCUPANT CAPACITY - a maximum of one bather for every 20 sq.ft. of surface area in a swimming pool or one bather for every 10 sq.ft. of surface in a spa.
- * NO DIVING ALLOWED - Must be posted at all pools that have a maximum depth of less than 6 feet.
- * SPA WARNING SIGN: with the following language:
 - Elderly persons, pregnant women, infants and those with health conditions requiring medical care should consult with a physician before entering a spa.
 - Unsupervised use by children under the age of 14 is prohibited.
 - Hot water immersion while under the influence of alcohol, narcotic drugs or medicines may lead to serious consequences and is not recommended.
 - Do not use alone.
 - Long exposure may result in nausea, dizziness, or fainting.
- * SPA EMERGENCY SHUT-OFF SWITCH-Required for all spa pools equipped with an emergency shut-off switch.

POOL OPERATION

Pool Closure - The swimming pool or spa must be closed to all bathers if one of the following conditions exist:

- * When the pool water is so cloudy or murky that the main drain is not visible from the deck.
- * When the main drain cover is improperly secured, broken, or missing
- * If chlorine (stabilized) residual is less than 1.5 ppm or less than 1.0 ppm unstabilized chlorine (include bromine levels)

Pool Supervisor - Each pool is required by State law to have a Pool Supervisor. He/she is responsible for assuring the pool and or spa is safe for bather use. The responsibilities of the Pool Supervisor consist of the following:

- * Test and record the levels of Free Available Chlorine and pH on Daily Record Sheet.
- * Verify that all safety equipment and warning signs are in good repair, accessible and visible to bathers in the pool area.
- * Inspect the deck, fencing, and recirculation equipment on a routine basis to assure they are in good repair.

Certified Pool Operator - It is the recommendation of this Department that all Pool Supervisors become Certified Pool Operators. For more information contact this Department at (619) 338-2222.

RECIRCULATION SYSTEM

The purpose of the filtration and disinfection systems are to remove contaminants from the water and limit the growth of bacteria. This can best be accomplished when all components of the recirculation system are maintained in good working order. The basic components consist of PUMP, FILTER, CHLORINATOR, RETURN INLETS, GAUGES, SKIMMERS, AND MAIN DRAIN.

COMPONENTS

PUMP - The pump is the heart of the recirculation system. It draws water from the pool via the skimmers and main drain and then pushes it through the filter and the remainder of the recirculation system and back to the pool.

FILTER - The filter removes very small particles from the water. As the water passes through the filter chamber the particulate matter adheres to the filtering media. The three types of filters which are most commonly used are Diatomaceous Earth (D.E.), High Rate Sand, and Cartridge.

CHLORINATOR - An automatic chlorinator must be installed on each recirculation system in order to continuously disinfect the water. Liquid, Tablet and Gas chlorine feeders are the most common types of automatic chlorinators. Safety concerns prohibit the use of chlorinators that float on the surface of the pool. Also the common practice of placing chlorine tablets in the skimmer is prohibited.

RETURN INLETS - The inlets return the filtered and chlorinated water back into the pool. Proper placement of the inlets on the side walls and/or on the bottom of the pool is necessary to obtain a uniform distribution of clean water returning to the pool.

SKIMMERS - The skimmers, as the name implies, skim leaves and other debris from the surface of the water. Since most of the contaminants in a pool are located on the surface of the water at least 75% of the flow should be drawn through the skimmers. For the skimmer to function properly it must have all of its components in good repair, most importantly, the skimmer weir must be in place. The weir is the pivoting door or flap located at the skimmer throat, its function is to break the surface tension of the water and allow for maximum flow through the skimmer. Without the weir in place the skimmer will not function properly.

MAIN DRAIN - The main drain serves a dual purpose; first as a suction outlet for the filtration system and second, as a means for drainage of the pool.

FLOWMETER AND PRESSURE GAUGES - The flowmeter and pressure gauges allow the operator to determine the effectiveness of the recirculation system. The flowmeter, as its name implies, measures the flow of water through the recirculation system in gallons/minute. This reading allows the operator to determine the turnover rate of the pool (see Required Turnover Rates). Influent and Effluent pressure gauge readings measure the pressure difference across the filter. The Influent pressure gauge indicates the pressure inside the filter and the Effluent pressure gauge indicates the pressure outside the filter. As the filter collects and traps the dirt and debris on the filter media it requires more pressure to force water through the filter. This increase in the Influent pressure reduces the flow of water through the filter making it less effective.

In general, it is time to Backwash and or Clean the filter when the difference between the Influent and Effluent pressure readings exceed the clean filter pressure by 7 to 10 psi.

DECK, FENCING, AND GATES

To restrict access to the swimming pool or spa by small children, an enclosure must be provided around the pool area. The pool enclosure must meet the following criteria:

DESIGN AND CONSTRUCTION - The enclosure should be designed and constructed so it can not be climbed easily. Special care must be taken to ensure that climbable bushes or trees are not planted next to the enclosure.

FENCE DIMENSION - The enclosure shall be at least five feet in height with no space or openings greater than 4 inches.

GATES/DOORS - Gates and doors leading into the pool area must be self-closing and self-latching with the latch at least 42 inches above the ground level. Blocking or holding open gates or doors of the enclosure is prohibited.

DECKING - There should be a minimum continuous and unobstructed four-foot deck around the pool made of a concrete-like material that is slip-resistant and non-abrasive. Note: Materials such as wood or carpet are not approved for use as deck surfaces.

It is the recommendation of this Department that existing pools with living units which open directly to the pool area, such as courtyard pools, be fenced so as to reduce the risk of children gaining unintentional access to the pool.

Note: Be advised that all new fencing or modifications to existing fencing must be approved by this Department prior to installation.

WATER CHEMISTRY

Swimming pool and spa water chemistry is a very dynamic situation that requires monitoring by the Pool Supervisor and Pool Maintenance Service to ensure proper water balance. In order to provide proper water balance factors such as CHLORINE RESIDUAL, pH, CYANURIC ACID, TOTAL ALKALINITY, CALCIUM HARDNESS, TOTAL DISSOLVED SOLIDS AND WATER TEMPERATURE must be measured and properly balanced to ensure clean and safe water.

WATER TESTING - Frequent and accurate water testing is critical to assuring that proper water balance is maintained. DAILY OPERATIONAL RECORDS must be kept for each pool, noting the chemical readings and corrective action taken if needed. It is essential that a proper test kit be used when making daily tests. Your test kit must be able to measure FREE AVAILABLE CHLORINE (FAC). Be sure your test kit has that capability, because many kits on the market test TOTAL AVAILABLE CHLORINE (TAC). There are two easy ways to determine if you have the right test kit: (1) by the name of the test reagent, and (2) by the color indicated by the test.

FREE AVAILABLE CHLORINE reagent is DPD#1 and gives a positive indication with a PINK color.

TOTAL AVAILABLE CHLORINE reagent is OTO and gives a positive indication with the color YELLOW. OTO test kits are not approved for use by this Department.

Once again the State law requires testing for Free Available Chlorine (PINK) not Total Available Chlorine (yellow). So be sure you have the correct test kit.

CHLORINE - When dealing with swimming pool water chemistry you will encounter 3 different forms of Chlorine and it is important to understand the differences between those forms. The three forms are Free Available Chlorine (FAC), Combined Available Chlorine (CAC) and Total Available Chlorine (TAC).

FREE AVAILABLE CHLORINE (FAC) Chlorine in this form acts as an excellent disinfectant and a residual of 1.5 parts per million must be constantly maintained if cyanuric acid (stabilizer) is used in the pool. If cyanuric acid is not used, then a FAC residual of 1.0 ppm must be maintained. Without an adequate free chlorine residual in the water, bacteria will thrive, thus increasing the risk of the bathers becoming ill.

COMBINED AVAILABLE CHLORINE occurs when free available chlorine combines with ammonia and nitrogen compounds (sweat, body oils and urine) to form compounds called chloramines. Chloramines are responsible for most eye irritation and odor complaints from bathers. To eliminate chloramines from the pool/spa, additional chlorine must be added. The amount of chlorine that must be added to eliminate chloramines, called breakpoint level, is approximately 10 times greater than the amount of combined chlorine measured in the pool/spa water.

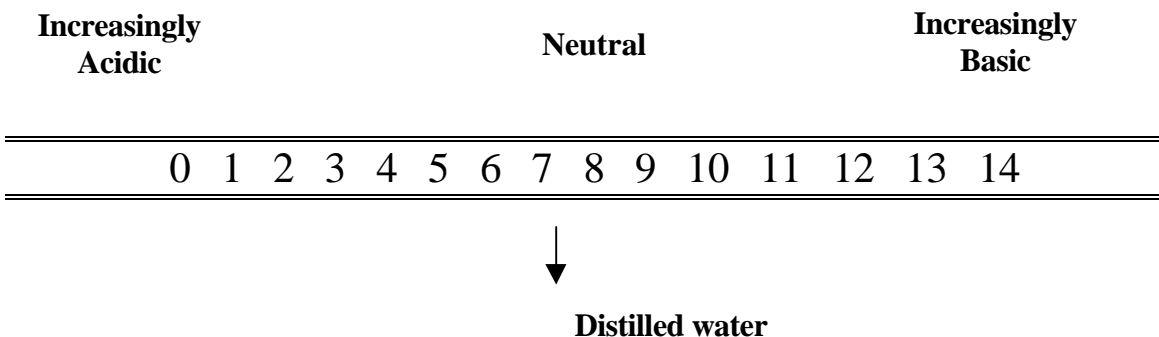
TOTAL AVAILABLE CHLORINE (TAC) is the final form of chlorine observed in swimming pool water chemistry. Total Available Chlorine is simply the sum of the amount of FAC + CAC = TAC

NOTE: MAXIMUM CHLORINE RESIDUAL - Although State code does not indicate a maximum allowable level of Chloride in swimming pools or spas, it is the position of the Department of Environmental Health that the Free Chloride residual should not exceed ten (10) ppm. If the chlorine residual is in excess of 10 ppm the operator of the pool/spa will be instructed to lower the chlorine level below 10 ppm. If the chlorine level is greater than fifty(50) ppm the pool/spa will be closed until the chlorine level is below 10 ppm.

pH –

pH is a measurement of Hydrogen ion concentration, which more simply is a measure of the acidity or alkalinity of the pool water. The required range of pH is 7.2 to 8.0, which is slightly basic on the pH scale. Chlorine is more effective when the pH is adjusted between 7.2 and 7.6. Problems will arise if the pH is not maintained between the required legal range 7.2 to 8.0.

pH SCALE



Problems can arise when pH is not properly adjusted.

The following can result when pH is maintained above 8.0.

- * Scale formation in plumbing, equipment and on pool walls
- * Cloudy water
- * Reduction in the effectiveness of Chlorine
- * Eye irritation

The following can result when pH is maintained below 7.2.

- * Corrosion of metal in pool equipment which can reduce the life of the equipment and also cause staining of the pool plaster.

- * Etching of plaster
- * Eye and skin irritation.

CYANURIC ACID - Cyanuric acid, also known as conditioner or stabilizer, is a chemical that is added to reduce the degrading effects of sunlight on free available chlorine. The ideal level of cyanuric acid is between 30 to 70 ppm. The maximum legal level of cyanuric acid is 100 ppm. The most effective method of reducing cyanuric acid level in the pool is to partially drain the pool and add fresh water. Testing for cyanuric acid levels should be made monthly and recorded on the Daily Records Sheet.

THE FOLLOWING TESTS ARE NOT REQUIRED BUT THEY ARE RECOMMENDED SO THAT THE POOL OPERATOR HAS A BETTER OVERALL VIEW OF THE CONDITION OF THE POOL WATER.

HARDNESS - Hardness is the total amount, in ppm, of minerals in the water. Calcium and magnesium make up a majority of the hardness content. Water hardness levels above 400 ppm may cause scaling in pipes and heater, or on the pool plaster. You should check with your pool service to determine the best way to lower calcium hardness level in your pool.

TOTAL ALKALINITY - Total alkalinity is the quantitative measurement, in ppm, of the alkaline substances in the pool water. The recommended range of total alkalinity is 80 to 120 ppm. Low total alkalinity levels may cause the pH level to fluctuate dramatically (pH bounce) when chemicals are added to the pool water. High total alkalinity levels may cause high pH levels and may also cause the water to become cloudy.

TOTAL DISSOLVED SOLIDS (TDS) - TDS is the amount of all materials in the pool water which would be left behind if all the water was evaporated. TDS levels above 2,000 ppm may reduce the effectiveness of the chlorine and can cause increased cloudiness of the pool water. To reduce the TDS levels the pool should be partially drained and fresh water added.

FECAL ACCIDENTS IN PUBLIC SWIMMING POOLS

The purpose of this document is to provide public pool operators and technicians recommended procedures and guidelines to follow in the event of a fecal accident. The recommended procedures are applicable to all types of public pools (i.e., swimming, wading, special use, and spas).

When a fecal contamination of a public pool occurs, the following should be done:

Instruct pool management to have all pool users exit the pool. The pool is to be closed from use while the sanitizing procedures are being followed.

Remove all visible fecal material. If a pool water vacuuming device is used, the wasted water should discharge to the sewer, not back into the pool recirculation system.

Equipment used to remove visible fecal material is to be thoroughly cleaned and sanitized prior to storage.

Raise and maintain a free chlorine residual in the pool water and maintain that residual for the length of time necessary to attain a “9600 contact time” equivalent. In order not to introduce excessive levels of stabilizers into the pool water, only non-stabilized chlorine compounds should be used. The “9600 contact time” equivalent formula is:

$$9600 = \text{Free Chlorine Residual} \times \text{Minutes}$$

EXAMPLE: Free chlorine residual raised to 20ppm. This residual would need to be continuously maintained for 480 minutes (8 hours) in order to reach the “9600 contact time” equivalent.

$$9600 = 20\text{ppm} \times 480 \text{ Minutes}$$

EXAMPLE: Free chlorine residual raised to 40ppm. This residual would need to be continuously maintained for 240 minutes (four hours) in order to reach the “9600 contact time” equivalent.

(Since most commonly available pool water test kits cannot test for the elevated residuals needed in this procedure, serial dilutions of the tested pool water may need to be done.)

See attachment for the amount of chlorine compound required to attain a desired free chlorine residual.

Pool operators may use higher or lower free chlorine residuals if so desired. This will reduce or increase the amount of contact time required as shown in the previous examples.

The pH of the pool water should be between 7.2 and 7.6.

The recirculation/filtration system should be continuously operated during the sanitization-contact time period. The filters should be backwashed and filter material replenished as required, as the mid-point of contact time period, and again at the end of the period prior to placing the pool back into use. Disassembly of the filters for interior cleaning is no longer specifically recommended, as the filter interior and parts will be exposed to the “9600 contact time” equivalent.

Small volume public pools (spas and waders), as an alternative, may be completely drained of all water, provided it is discharged to the public sewer or approved disposal system. Sanitizing of all pool interior surfaces and recirculation equipment will be required which would expose the interior pool and pumping-filtration equipment surfaces to the “9600 contact time” equivalent. A solution of one part 12% sodium hypochlorite in 20 parts of clean water can be used to sanitize interior parts and surfaces (6000ppm free chlorine for one minute and thirty-six seconds).

When the sanitizing-contact time period is completed, the pool can be re-opened for bathing provided excess free chlorine levels are reduced to acceptable values, the pH balanced as needed, the filter(s) recharged, and the recirculation system is operating.

Dosages of non-stabilized chlorine compounds to treat 10,000 gallons of pool water

To raise free chlorine by:	1ppm	5ppm	10ppm
Calcium hypochlorite (“Cal-Hypo” – 65% granular or tablets. pH=11.8)	2 oz.	10 oz.	20 oz.
Sodium hypochlorite (bleach-pool strength - 12-15% - liquid pH=13.0)	13 fl.oz.	½ gal.	1 gal.
Lithium hypochlorite (35% - powder pH=10.7)	4 oz.	20 oz.	40 oz.

(Although gaseous chlorine is non-stabilized, direct injection into the pool water is not recommended.)

EXAMPLE: Pool volume is 100,000 gallons. Pool operator wants to use 20ppm free chlorine for contact. How much of the various chlorine-containing compounds will be needed to raise the free chlorine residual to 20ppm?

Solution (using sodium hypochlorite): One gallon of sodium hypochlorite will impart a 10ppm rise in 10,000 gallons of water. In 100,000 gallons of water, 10 gallons will then provide a 10ppm rise. Since 20ppm is the desired level, 2 x 10 gallons = 20 gallons.

Solution (using calcium hypochlorite): 20 oz. (1.25 lbs.) of calcium hypochlorite will impart a 10ppm rise in 10,000 gallons of water. In 100,000 gallons, 200 oz. (12.5 lbs.) will then provide a 10ppm rise. Since 20ppm is the desired level, 2 x 200 oz. = 400 oz. (25 lbs.).

Solution (using lithium hypochlorite): 40 oz. (2.5 lbs.) of lithium hypochlorite will impart a 10ppm rise in 10,000 gallons of water. In 100,000 gallons of water, 400 oz. (25 lbs.) will then provide a 10ppm rise. Since 20ppm is the desired level, 2 x 400 oz. = 800 oz. (50 lbs.).

The pool operator should be cautioned that the three chlorine compounds recommended in this procedure all have high pH's. Addition of these chemicals to the pool water will increase the pH. Chemical balancing of the water may be needed to maintain the optimal pH range of 7.2 – 7.6.

FREQUENTLY ASKED QUESTIONS:

- Q. Are children with diapers allowed in the pool or spa?
- A. There are no Health and Safety Codes which prohibit the use of pools or spas by children wearing diapers. It is recommended that plastic pants be worn over the diaper.
- Q. Is there minimum age requirements to use the spa?
- A. No, there is not a minimum age to use the spa, but the Health and Safety Code does prohibit the unsupervised use of the spa by children under the age of 14.
- Q. Is there a minimum height requirement for use of the spa?
- A. No, there is no minimum height requirement.
- Q. What should I do if I find the pool has been closed by the Health Department?
- A. Attempt to contact the field specialist that closed the pool if you are unable, call Duty Specialist at (619) 338-2222.
- Q. How often are pools/spas inspected?
- A. Routine inspections are done 3 times per year.

GLOSSARY

ACID: A chemical that provides hydrogen ions. An acid lowers the pH of water.

ALGAE: The simplest member of the plant kingdom. Algae are microscopic, single-celled forms of plant life that exist in virtually all surface water and most ground water. Green, Black and Mustard are the most frequently encountered species in pools and spas.

BACKWASH: A process by which the direction of the flow of water going through the filter is reversed dislodging trapped contaminants from the filter media and directing the debris to the sewer.

BREAKPOINT CHLORINATION: The process of adding sufficient free available chlorine or other oxidant to chemically convert chloramines and ammonia-nitrogen compounds to inert nitrogen gas.

BROMINE: A disinfectant added to swimming pool or spa water to destroy and inhibit bacteria and algae growth in addition to oxidizing unwanted organic and nitrogenous waste.

CALCIUM HARDNESS: The calcium content of water expressed in ppm.

CHLORAMINES: See Combined Available Chlorine

CHLORINE: A disinfectant added to swimming pool or spa water to destroy and inhibit bacterial and algae growth in addition to oxidizing unwanted organic and nitrogenous waste.

CHLORINATOR: Device used to automatically dispense chlorine to pool or spa water. Devices can dispense chlorine in tablet, liquid or gaseous form.

COMBINED AVAILABLE CHLORINE (CAC): Known also as chloramines, CAC are the undesirable compounds formed when insufficient levels of free available chlorine chemically react with ammonia and other nitrogenous compounds.

CYANURIC ACID: Cyanuric Acid also known as Conditioner or Stabilizer, is a chemical which is added to pool water to reduce the degrading effects of sunlight on Free Available Chlorine.

DIATOMACEOUS EARTH: Media composed of small, fossilized remains of unicellular plankton or colonial algae (diatoms) that act as filtering microscreens to remove insoluble particles from pool or spa water.

DISINFECTION: The process of killing and/or inhibiting the growth of bacteria and viruses to prevent the transmission of disease.

DPD: DPD is chemically N,N-diethyl-p-phenylenediamine. An organic colorimetric indicator used for chlorine, bromine, ozone and other reactive oxidizers. DPD#1 indicates (FAC) and DPD#3 indicates (TAC).

EFFLUENT PRESSURE: The pressure of the water in the recirculation system outside of the filter, measured in pounds per square inch (psi).

FILTRATION: The passage of a fluid through a porous medium to remove matter (particles) held in suspension.

FLOWMETER: A metering device that measures flowrate.

FLOW RATE: The rate of water flow through a recirculation system usually expressed in gallons per minute.

FREE AVAILABLE CHLORINE (FAC): Chlorine that is not combined. Defined as the sum of undissociated hypochlorous acid (HOCl) and dissociated hypochlorite anion.

INFLUENT PRESSURE: The pressure of the water inside the filter measured in (psi)

HALOGEN: Any element found in Group VIIA of the Periodic Table. The halogens include fluorine, chlorine, bromine, iodine, and astatine. Because of their tremendous chemical reactivity, the halogens never occur free in nature.

MURIATIC ACID: A strong mineral acid composed of one atom of hydrogen and one atom of chlorine, also known as Hydrochloric acid. Commonly used to lower pH and acid wash plaster.

OTO: A colorimetric indicator for Total Available Chlorine (TAC) Also known as orthotolidine, it gives a yellow positive indication for (TAC), not approved for use by this Department.

OCCUPANT CAPACITY: Is the maximum number of bathers allowed in swimming pool or spa. The capacity is determined by the surface area of the pool. The occupant capacity for a Swimming Pool is one bather for every 20 square feet area; for a Spa pool one bather for every 10 square feet of surface area.

pH: Mathematically defined as the negative log of the hydrogen ion concentration. pH is a measure of the acidity or basicity of water.

PHENOL RED: Chemically known as phenolsulfonphthalein. Phenol red is an organic acid-base indicator that exhibits a yellow to red color change as the pH increases from 6.8 to 8.2.

SODA ASH: Commonly used to increase the pH of pool water.

SUPERCHLORINATE: Is the process of increasing normal daily concentration of Free Chlorine for the purpose of destroying ammonia build-up in the pool and control of algae growth.

TURNOVER RATE: The time required for the recirculation system to filter the entire volume of the pool or spa once.

TOTAL ALKALINITY: The quantitative measurement of alkaline components present in water to act as a buffer against rapid pH changes.

TOTAL AVAILABILITY CHLORINE (TAC): The sum for free available chlorine (FAC) and combined available chlorine (CAC).

TRICHLOR TABLETS: Commonly used form of stabilized chlorine that is used in tablet feed chlorinators.

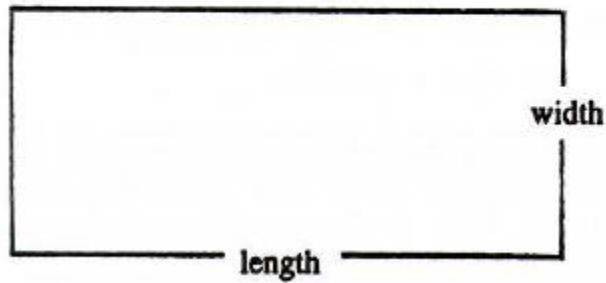
WEIR: Component of a Skimmer, with the function of breaking the surface tension of the pool water allowing for maximum suction through the skimmer. Weir can be identified as the flap or pivoting door at the front of the skimmer throat.

POOL SIZING & FORMULAS

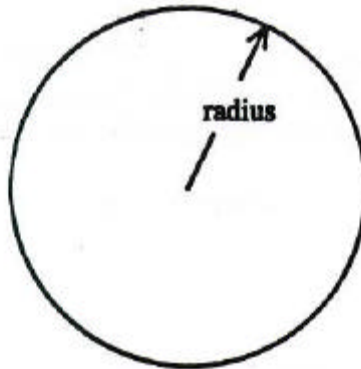
It is essential to know the size and volume of the pool or spa you are operating. The following steps and formulas will assist in determining the size and volume of the pool. First determine the SURFACE AREA, then AVERAGE DEPTH, and finally VOLUME OF POOL.

SURFACE AREA

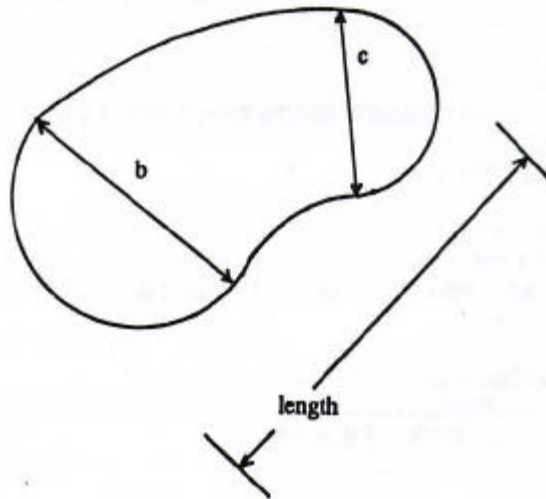
Rectangle: $S.A. = \text{length} \times \text{width}$



Circle: $S.A. = 3.14 \times \text{radius}^2$



Kidney: S.A. = $0.45 \times (b+c) \times \text{length}$



AVERAGE DEPTH

$$\text{A.D.} = \frac{(\text{Depth of deep end}) + (\text{Depth of shallow end})}{2}$$



VOLUME OF POOL

Volume equals the Surface Area multiplied by the Average Depth of the pool or spa multiplied by 7.5 which is the conversion from cubic feet to gallons.

$$\text{Volume} = (\text{S.A.}) \times (\text{Ave. Depth}) \times (7.5)$$

EXAMPLE

A pool that is 15 feet by 30 feet with a depth of 5 feet in the deep end and 3 feet in the shallow end would have a surface area of 450 square feet and an average depth of 4 feet and a volume of 13,500 gallons.

Surface Area = 15 ft. x 30 ft = 450 sq. ft.

Average depth = $\frac{5 \text{ ft.} + 3 \text{ ft.}}{2} = 4 \text{ ft.}$

Volume = (450 sq. ft.) (4 ft.) (7.5) = 13,500 gallons

TURNOVER RATE

Turnover rate is the time required to recirculate the entire volume of water in the pool or spa through the filter.

FLOW RATE

Flow rate is the amount of water going through the recirculation system usually measured in gallons per minute.

Flow rate = $\frac{\text{Volume of the pool}}{\text{Turnover rate}}$

REQUIRED TURNOVER RATES

The required turnover rates vary depending on the type and age of the pool. There are three types of pools: (1) Swimming Pool, (2) Wading Pool and (3) Spa Pool. Pools built before 1986 have a lower turnover rate required than those pools built after 1986. See the table below.

Required Turnover Rates

Type of Pool	Before 1986	After 1986
Swimming Pool	8 hours	6 hours
Wading Pool	2 hours	1 hours
Spa Pool	1 hour	1/2 hour

Example:

What would be the required turnover and flow rate for a 13,500-gallon swimming pool built in 1988?

Answer:

The required turnover rate is 6 hours or 360 minutes and the Flow rate is required to be 37.5 gallons/minute.

$$\text{FLOW RATE} = \frac{13,500 \text{ gallons}}{360 \text{ minutes}} = 37.5 \text{ gpm}$$

POOL/SPA AND EQUIPMENT DATA:

SWIMMING POOL:

Date of Construction _____

Surface Area _____ sq. ft.

Volume _____ gallons

Clean Filter Pressure _____ psi

Required Turnover Rate _____ hours

Required Flow Rate _____ gpm

Occupant Capacity _____ bathers

SPA POOL:

Date of Construction _____

Surface Area _____ sq. ft.

Volume _____ gallons

Clean Filter Pressure _____ psi

Required Turnover Rate _____ hours

Required Flow Rate _____ gpm

Occupant Capacity _____ bathers